

IN THE CLAIMS

Claims 2-3, 13-17, 19, and 24 have previously been cancelled without prejudice.

Please cancel claim 9 without prejudice.

Please amend claims 1, 25, and 31.

Please enter the pending claims, including claims 1, 4-8, 10-12, 18, 20-23, and 25-33, as follows:

1. (Currently Amended) An apparatus comprising:
 - a holder to mount a substrate;
 - a stage disposed below said holder;
 - an imaging system disposed at a first height ~~vertically~~ above an opaque defect on said substrate, said imaging system including an electron column;
 - a gas delivery system comprising a nozzle with a diameter of 100-300 microns disposed at a second height over said opaque defect at a tilt angle of 45-70 degrees from vertical, a distance of 50-150 microns, and an angular dispersion of 5-25 degrees to dispense a reactant gas and a carrier gas from a reservoir ~~wherein said second height is lower than said first height;~~ and
 - an electron scanning delivery system disposed at ~~said second~~ a third height over said opaque defect ~~at said tilt angle and said distance~~ to direct electrons in a range of 0.3-3.0 keV towards said reactant gas ~~wherein said gas delivery system~~

~~and said electron scanning delivery system are disposed on opposite sides of said imaging system;~~

a focusing system to highly focus said electrons into an electron beam having a tail diameter of 5-125 nanometers on said opaque defect;

a monitoring means for a secondary electron current that interacts with said reactant gas; and

a detecting means for an endpoint of a chemical etch of said opaque defect.

2. - 3. (Cancelled)

4. (Original) The apparatus of claim 1 wherein said substrate comprises a transmissive DUV mask.

5. (Previously Presented) The apparatus of claim 4 wherein said opaque defect comprises chrome and said reactant gas comprises chlorine and oxygen.

6. (Original) The apparatus of claim 1 wherein said substrate comprises a reflective EUV mask.

7. (Previously Presented) The apparatus of claim 6 wherein said opaque defect comprises an absorber and said reactant gas comprises Xenon Fluoride (XeF₂).

8. (Original) The apparatus of claim 1 wherein said opaque defect comprises Carbon and said reactant gas comprises water vapor or oxygen.

9. (Cancelled)

10. (Previously Presented) The apparatus of claim 1 further comprising a computer to control dwell time and scan rate of said electron scanning delivery system.

11. (Previously Presented) The apparatus of claim 1 further comprising an acceleration system to provide a low acceleration voltage for said electrons.

12. (Previously Presented) The apparatus of claim 1 further comprising a computer to control refresh time and retrace time of said electron scanning delivery system.

13. - 17. (Cancelled)

18. (Previously Presented) The apparatus of claim 1 wherein said gas delivery system is further to dispense a carrier gas towards said opaque defect.

19. (Cancelled)

20. (Previously Presented) The apparatus of claim 1 wherein said reactant gas is to adsorb to said opaque defect and is to become disassociated.

21. (Previously Presented) The apparatus of claim 1 wherein said chamber comprises a pressure of about 0.500-10.000 milliTorr (mT) locally over said opaque defect.

22. (Previously Presented) The apparatus of claim 1 wherein said electrons form a beam comprising a current of about 0.050-1.000 nanoAmperes (nA).

23. (Previously Presented) The apparatus of claim 1 wherein said electrons form a beam comprising a tail diameter of about 5-125 nm.

24. (Cancelled)

25. (Currently Amended) An apparatus for repairing an opaque defect on a mask without ion implantation or knock-on of atoms comprising:

a chamber;

a stage disposed in said chamber;

a holder disposed over said stage;

a mask disposed over said holder;

an opaque defect disposed on said mask;

an imaging system disposed at a first height directly above said

opaque defect, said imaging system including an electron column;

a gas delivery system disposed at a second height and a tilt angle over said opaque defect ~~wherein said second height is lower than said first height;~~

an electron scanning delivery system disposed at ~~said second~~ a third height and ~~said tilt angle~~ over said opaque defect ~~wherein said gas delivery system and said electron scanning delivery system are disposed on opposite sides of said imaging system;~~

electrons disposed over said opaque defect, wherein said electrons interact with a gas that is adsorbed and dissociated on said opaque defect without damaging underlying layers;

a monitoring means for a secondary electron current that interacts with said gas;

a detecting means for an endpoint of a chemical etch of said opaque defect; and

a pumping system disposed in said chamber to evacuate volatile byproducts.

26. (Previously Presented) The apparatus of claim 25 wherein said electrons comprise a range of 0.3-3.0 keV.

27. (Previously Presented) The apparatus of claim 25 wherein said electron scanning delivery system further comprises focusing controls.

28. (Previously Presented) The apparatus of claim 25 wherein said electron scanning delivery system further comprises focusing and scanning controls that are more sophisticated than in an SEM.

29. (Previously Presented) The apparatus of claim 25 wherein said gas comprises water or oxygen.

30. (Previously Presented) The apparatus of claim 25 wherein said gas comprises Xenon Fluoride (XeF₂).

31. (Currently Amended) A mask repair system comprising:

a chamber, said chamber to hold a mask;

an imaging system disposed in said chamber at a first height to locate an opaque defect on said mask, said imaging system including an electron column;

a gas delivery system disposed in said chamber at a second height and a tilt angle to dispense one or more gases from reservoirs through nozzles towards said opaque defect ~~wherein said second height is lower than said first height;~~ and

an electron scanning delivery system disposed in said chamber at ~~said second~~ a third height and ~~said tilt angle~~ to provide a highly focused beam of electrons with an electron beam size smaller than 30% of smallest critical defect to interact with said one or more gases adsorbed and dissociated over said opaque defect ~~wherein said gas delivery system and said electron scanning delivery system are disposed on opposite sides of said imaging system~~

a monitoring means for a secondary electron current that interacts with said one or more gases; and

a detecting means for an endpoint of a chemical etching of said opaque defect.

32. (Previously Presented) The apparatus of claim 31 wherein said electrons comprise an acceleration voltage of about 1.0 keV or less.

33. (Previously Presented) The apparatus of claim 31 wherein said chemical etching is reaction-limited and not mass transfer-limited.